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ABSTRACT

Schools adapt to change slowly while technological advances are progressing at an exponential rate. Five inventions have dramatically changed the human ability to teach: speech, writing, the printing press, the computer, and the laser videodisc. Currently, schools rely primarily upon the first three, but the latter two represent technological advances which have the potential of significant impact upon education within the next 20 years. For schools to remain competitive and relevant, it will be necessary for teachers to become technologically literate and for the profession to develop and adopt instructional systems which are less person-intensive, e.g., microcomputer technology. The Mobile County (Alabama) Public Schools have used microcomputers in three noteworthy ways: in instruction using a 20-station high school microcomputer laboratory; in management for scheduling high school record keeeping and grade reporting; and as a means of sorting and processing student information in an elementary school. The annotated bibliography of books and periodicals for additional reading which comprises the second section of this paper includes subscription information for 26 periodicals. (Author/LMM)

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TECHNOLOGICAL FUTURES IN EDUCATION

by

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Technological Futures in Education

George E. Uhlig, Ed.D.

Many contemporary authors agree that there have only been five inventions in the history of man which have dramatically changed our ability to teach. These are the inventions of speaking, writing, the printing press, the computer, and the videodisc. Three of these are "technological" and two are very recent.

Schools have difficulty maintaining currency in those areas where change is the most rapid. A capable English teacher, competent in 1960, will probably be competent in 1980. The English language is relatively stable, and while new words are occasionally added and a few become obsolete each decade, many concepts remain the same. A verb is a verb; a noun is a noun; a compound sentence is a compound sentence. Mathematics is a relatively stable field, but dynamic changes can take place which may make unprepared teachers obsolete. The introduction of the New Math a decade ago is an example. Two plus two was, at least in base 10, still 4; but the method of teaching the concept, for example, of additivity, was different. Many teachers had trouble adapting. Staying current in the sciences is even more difficult: DNA and RNA were not in most textbooks ten years ago. Political geography can change overnight. But it is in the field of theoretical and applied technology where schools have been the slowest to adapt to the 1980s. It is useful to consider technology in terms of teaching about it (technological literacy) and using it to increase teaching effectiveness (technological application).

It is not only the teachers but also the systems which have

trouble responding to change. Curriculum change is dependent upon many factors: the willingness of the lay board to initiate or institute curricular evaluations or modifications; leadership and vision from the superintendent, curriculum officers and principals; curriculum committee responsiveness; and the teachers themselves. Finally, most changes cost money in the short term if not the long and because it is extremely difficult to place a dollar value on a student's increased learning efficiency or effectiveness, it is impossible to make good cost-effectiveness arguments for a specific curricular or instructional change. However, some things can be demonstrated. My 12 year old daughter is learning touch typing from a microcomputer at home in her spare time. At the rate she is progressing she will probably become a proficient typist in about a year. It will not show up on her school transcript, but neither will she need to spend five hours per week for 36 or 72 weeks in typing class at school. Technology is saving her 180 to 360 classroom hours, as well as the out of class work that might have been required, which will allow her to take one or two other elective classes not yet adapted to technology. Moreover, she is learning typing when she is ready and interested. This microcomputer-controlled system, by the way, gives her word by word, sentence by sentence, or paragraph by paragraph analysis immediately, including words per minute, error rates, and specific strokes which require further drill. It is fascinating to imagine what 20 such systems could do in the school to change dramatically the way in which we develop typing skills in students.

It is often instructive to devote time and energy considering the

future of technology and the role schools might play in learning. One can learn much about one's colleagues by the way in which they project themselves and society into the future. One can also learn much about one's own value structure from the exercise. Of course, it is impossible to know what unknown variables or "wild cards," as at least one futurist has called them, will emerge to make our predictions imperfect. In the pre-1970 days most predictions about the industrial future of the United States were based upon the almost limitless supply of inexpensive, portable energy. The oil embargo of 1974 demonstrated conclusively the potential effect of even one variable on any set of related predictions. Should science find an inexpensive, easily manufactured synthetic fuel, the significance of energy cost variables might well return to their pre-1974 status. Even a limited nuclear war (if there is such a thing) could be expected to have both short-term and long-term ramifications on populations as well as upon economic, industrial, military, and scientific development.

Unanticipated variables notwithstanding, a more inherent difficulty lies in the inability of many people to conceive any growth trends which are greater than linear. One of the classic demonstrations is to take a piece of common typing paper, fold it in half, then in half again, and continue to fold it a total of 50 times. How thick (or high) would the resulting piece of folded paper be? Most people who venture an answer suggest a length within a range from a few inches to a few feet. Depending upon the weight of the paper, the thickness of a piece is approximately .0043 or 43/10000 inch. By the time the paper has been doubled ten times, it is approximately 4.4

inches thick. By the time it has been doubled twenty times it is approximately 370 feet thick. Doubling it another ten times brings it to a thickness of approximately 72 miles. By the time it has been doubled 40 times it would be 74,000 miles thick. By the time it has been doubled 50 times it would constitute a height or thickness of nearly 36 million miles which would carry it out beyond the moon and into outer space. When faced with this answer, many people are skeptical indicating that (a) the arithmetic must be wrong (it isn't), or (b) that doubling a piece of paper fifty times is impossible (true, but irrelevant). Exponential growth curves are extremely difficult for most people to comprehend and appreciate.

This partially explains why some experts can get very excited about world population growth rates while the typical layman or politician dismisses the concern as the result of poor arithmetic or faulty prediction models. It also is helpful in understanding why society and education are often slow to reap the rewards of advancing technological systems.

Information, a raw material which is the basic ingredient in producing an educated person, is increasing geometrically. The concept of acquiring knowledge by having the teacher at one end of the log and the student at the other, as inviting as it may sound, fails an important test: it is virtually impossible for an individual to achieve or maintain currency in his or her field if that field is growing as rapidly as most fields of knowledge are today. The vision of the teacher in front of thirty students acting as a dispensor of knowledge and wisdom has to be replaced with a more realistic

approach: the teacher as manager and provocateur of learning. This concept is difficult to achieve today without mastering and using electronic information technology which is currently available and affordable, and which is becoming increasingly sophisticated.

Teacher education programs and public schools have been historically slow in adapting new technology. Television was in 50% of the homes in the United States before it emerged as a teaching tool. Films were in movie theaters across the nation before the educational film became integrated into educational technology. It was several years after ball-point pens were common writing implements in the home and office before many schools gave up the ink well and straight pen, and schools are still teaching business education courses on manual typewriters while businesses are exchanging electric typewriters for electronic word processing equipment. Only in some of the heavily federally financed technical fields such as vocational agriculture and military applications have the new technologies and scientific findings been quickly imparted.

There are many reasons to explain the difficulty with which education accepts technology. In-service training programs for teachers have never been sufficiently planned, required, and conducted in a manner which would guarantee that technology was included. School finances have been hard put to keep up with building and personnel demands, much less being able to change to meet the new demands of an increasing technological society. Even if schools had had the resources for these types of innovations, it seems unlikely that the required specialists could have been employed to handle the teaching

assignments or service the equipment. Higher education often outbids the secondary and elementary schools for instructors in technical areas, and business and industry outbid the universities. Finally, of course, is the fact that many people are simply resistant to change, particularly when the change is in a direction which they find threatening. Every technological advance in education, television, films, teaching machines, and computers, has carried with it the implied threat that it may replace the teacher. This threat is probably the result of overzealous promoters of the technology on the one hand and teacher ignorance concerning the limits of the technology on the other.

There appear to be two new technological advances which have the potential of significant impact upon education within the next 20 years. One of these has received many names, but the "silicon revolution" seems to summarize best the microelectronic, microprocessor, microcomputer revolution. The second is the development of videodisc technology.

We have known for a number of years that computers had a tremendous capability to assist in the management and instruction of the school. Teaching systems such as PLATO and TICCIT developed and were demonstrably effective, if expensive. Monumental data sets could be handled by the large systems such as the CDC 3600 and UNIVAC 1110. Man on the Moon landings would have been impossible without the assistance of large frame computers. These computers were large, expensive, required carefully controlled environmental conditions (e.g. heat, humidity), special security for awhile from destruction by

militant student groups on some campuses, and a formidable "language". Because of their complexity, tie-ins required dedicated telephone lines which escalated the cost to the user. Because the languages, particularly in the early years, were difficult to master, and because most of those who mastered the language could find well-paid positions in government or industry, the number of people who attempted to program computer-assisted efforts was limited. In the following two decades between 1960 to 1980 several technological advances occurred to change much of this.

First consider this. In 1960 you could order a computer which filled the equivalent of two to four standard classrooms, required temperature and humidity control, immense energy, and highly trained individuals to operate it. These machines were produced and sold at prices approaching $1.5 million. By 1980 the identical computing power could be produced on a silicon chip at the price of about $15.00, and the energy and environmental controls had been similarly reduced, as was the amount of knowledge needed to operate the system. One result: the pocket calculator replaced the slide rule as the primary tool of the practicing engineer. A second result is that students across the nation are completing arithmetic assignments, in school and at home, and to the distinct consternation of some parents and teachers, with inexpensive, hand held calculators rather than by the "tried and true" methods their elders used: paper and pencil, or counting on fingers and toes. It has been predicted that the personal computer will be as common in the home of 1985 as the color television is today. It should also become as common in the school since it has a

tremendous advantage as a teaching and learning tool, as well as being inexpensive and useful as a management tool. Research in certain kinds of learning has suggested several conditions which contribute to the most effective learning:

Instruction paced to meet the acquisition rate of the learner.

Immediate knowledge of results.

Absence of emotionally-charged negative response by the teacher.

Diagnosis of specific instructional needs.

Patience on the part of the teacher.

The computer is ideally suited to meet these conditions. (For those who would argue that a little planned impatience on the part of the teacher is sometimes necessary for effective learning to occur, impatience can be easily programmed into the computer.) Computers can also operate day and night, seven days per week, and the material they contain can be carried home in the evening on a "floppy disc"--a five inch record-sized memory which costs today about $3.50 for the equivalent of 100 pages of typewritten text material--and placed in the home computer for much more efficient homework assignment.

The other technology is the videodisc which has been called variously a "picture book in the round" and a "phonograph which plays pictures on your television set." Without attempting any comprehensive description of the laser and other electronic technology which has provided this capability, a videodisc has a diameter of about sixteen inches and looks like a long playing record which has been coated with a very shiny plastic cover. Each side of the disc can contain, currently, 54000 separate frames of information. A single frame might

contain, for example, a page of text from an encyclopedia. The current Encyclopedia Britannica Macropedia is 19 volumes with approximately 1200 pages per volume. It would be technically possible to place the entire set on several videodiscs. Additionally, because movement can be programmed into the disc the encyclopedia could virtually come alive on the screen. With the advanced videodisc players, moving from one frame to any other frame (the equivalent of turning, for example, from page 47 in Volume 2 to page 1148 in Volume 18) can be accomplished in about 2 seconds or less. This encyclopedia would weigh only several pounds, and could be reproduced for around $30. If you have priced a quality encyclopedia recently you can probably imagine the impact such a capability would have. The discs also have dual audio tracks which can provide either stereophonic sound or bilingual commentary. A skilled instructor, using the videodisc in combination with a microcomputer, can gain an enormous amount of class participation, far greater than is available with the usual audiovisual and educational aids found in most schools, and the teacher remains in complete control of the learning environment.

I have attempted, in the preceding pages, to present what I view as the potential effect of the microelectronic revolution on the schools of the future. Where, today, does Mobile stand in relation to this vision of the future and in comparison with contemporary public schools around the nation? It is impossible to describe the Mobile Public Schools' status without making at least a passing comment on the status of teacher preparation in the state with regard to technology and to view what other communities are doing.

At Crittenden Middle School in Mountain View, California, every student this year will learn to program a computer and many will pass a proficiency test on computer literacy. At Lyons Township High School District 204 in LaGrange, Illinois, a 25 station microcomputer laboratory is made available for training teachers and staff who volunteer for an eight-hour competency course. Nearly all have volunteered.

A recent study by the Northwest Regional Educational Laboratory (NOREL) found that approximately two-thirds of the school districts in the region were currently using computers, and an additional 30% were planning to adopt this technology within three years. NOREL also found that few teachers in the region had any formal exposure to computers, and those who did were primarily trained for one year on FORTRAN, an interesting but not necessarily relevant programming language for microcomputers. A recent survey of 24 college and university campuses in Alabama which prepare teachers found that very few had integrated computer education, technology, or literacy into the teacher education curriculum, and that none required any computer training for certification. The University of South Alabama College of Education appears to be on the forefront in the state in developing and utilizing microcomputers for instruction and classroom management; however, even their resources in the area are severely limited.

There are at least three applications of microcomputer technology in the district which are noteworthy. At the LeFlore Magnet High School in Toulminville a microcomputer laboratory with 20 stations has been established. In this program students can gain competency and

literacy on microcomputer applications during their high school program. One result is increased employability in a world of work where microelectronic and word processing skills are in great demand. A second result is a head start on classmates who choose to enter the sciences, business, or engineering in postsecondary institutions. At Davidson High School a microcomputer linked to a hard disc performs functions of scheduling, record keeping, and grade reporting. Other administrators from the schools who have viewed this relatively inexpensive system rate it as excellent. At Maryvale Elementary School in the southern area of Mobile county the principal and her staff utilize a microcomputer technology to handle, store and process student information. This provides the teachers and staff with nearly instantaneous information which is useful when meeting with a child's parents, when a child is ill and emergency information is needed and so forth. The school plans to add word processing capability and to interface the microcomputer with the main frame at the central office.

Thus it is evident that the Mobile County Public Schools have made some limited headway in developing microcomputer literacy and utilizing microcomputer technology. It also is argued by some that rapid development of technology is expensive. It should be noted that Mobile County Public Schools spends approximately $1200 per student per year, as compared to a national average of over $2200. The $1000 difference per student is the equivalent of approximately $28,000 per classroom per year. There is no doubt that the system could pursue a more extensive program of instructional literacy and effectiveness.

Attitude change can preclude skill acquisition. A first step

might be to have district-wide in-service sessions focusing on microcomputer applications to classroom and building-wide environment, and insist that all teachers and administrators participate. Second, the purchase of computers depends upon fund availability. Papert argues like this: in Mobile County the annual cost per student is about $1200. Over a 13 year period $15,600 is spent on each student. A personal microcomputer can be purchased for about $2000 or 13% of the total cost of the 13 year cost. If student teacher ratios are 30:1 now--a somewhat high estimate--a 13% increase in student teacher ratio would bring the average to 33:1 or 34:1. Can a teacher with 34 students and 34 microcomputers at his/her disposal be more effective than a teacher with a 30:1 ratio and no microcomputers available? The best evidence we have is that the answer is a resounding yes. It may well be that the Mobile County School System, or for that matter any system, cannot afford not to commit itself to modern microelectronic instructional technology.

SUGGESTIONS FOR FURTHER READING

If you are interested in reading further about the effects of the silicon revolution on your future and the future of the schools, you might want to review the following books and periodicals:

PERIODICALS:

Videodisc/Videotex. This quarterly journal was founded in 1980 and is currently the best source of information on videodisc technology. It is published by Microform Review Inc., 520 Riverside Ave., P. O. Box 405, Saugatuck Station, Westport, Connecticut, 06880. It is a relatively expensive journal: $15 per issue or $52 per year.

Infoworld. This newpaper is now published weekly and is probably the most popular source of information concerning microcomputer hardware and software developments. It is easily read by novices and experienced personal computer users and every issue carries reviews of new software. It is an excellent source of information on trade development. It can be ordered from Infoworld, 375 Cochituate Rd., Box 880, Framingham, MA 01701, or call 800-343-6474. $25 per year.

Compute! is subtitled the Journal for Progressive Computing and described as "the resource magazine for CPM/PET, Apple, Atari, and OSI." Published monthly, subscriptions are $20 per year and are available from the Circulation Department. Compute! Magazine, 515 Abbott Drive, Broomall, PA 19008.

Electronic Education is published ten times per year (September through June) by Electronic Communications, Inc., Suite 220, 1311 Executive Center Drive, Tallahassee, FL 32301. Cost is $10 per

year.

Incidentally, a recent issue of Electronic Education notes that you can obtain a free copy of "Children's Books for Computer Awareness and Literacy," a 1981 bibliography compiled by Elizabeth S. Wall, by sending a self addressed, stamped envelope to:

Bayshore Books
P. O. Box 848-B
Nokomis, Florida 33555

The Computing Teacher" is the journal for persons interested in the instructional use of computers." The journal emphasizes teaching about computers, using computers, teacher education, and the impact of computers on curriculum. It is the journal of the International Council for Computers in Education (ICCE). If you subscribe to the journal you automatically become a member of ICCE. It is NOT a journal focusing strictly on microcomputers; it deals with computer applications with no specific regard for hardware configuration.

You can subscribe to The Computing Teacher for $14.50 for 9 issues by writing to the Department of Computer & Information Science, University of Oregon, Eugene, OR 97403.

Educom is the bulletin of the Interuniversity Communications Council which is a non-profit consortium of over 350 colleges and universities founded in 1964 to promote the use of computing, communications, and information technology in higher education. Educom assists colleges and universities through research, publications, meetings, resource sharing and other cooperative efforts. Subscriptions are free to members of Educom, or $15.00

per year for non members. P. O. Box 364, Princeton, NJ 08540. This periodical focuses on general computing issues and is not restricted to microcomputers. In fact, this magazine is probably of most interest to members of institutions which have large mainframe computers in place.

Electronic Learning is subtitled "The Magazine for Educators of the 80's," and is published by Scholastic, Inc. It is a new publication founded in 1981. Subscription information can be obtained by writing Electronic Learning, 902 Sylvan Ave., Englewood Cliffs, NJ 07632. Subscriptions are $19.00 per year for 8 issues.

Creative Computing has been published for nearly nine years. With the growth of microapplications the magazine has also expanded. It is published monthly by Creative Computing, P. O. Box 789-M, Morristown, NJ 07960. The cost is $20.00 per year and there is a toll free number (800) 631-8112. The magazine covers evaluations of hardware and software, applications, and many articles and departments.

Softside is in its fifth year of publication. Published monthly for $30.00 per year, it is available from Softside Publications, 515 Abbott Drive, Broomall, PA 19008. It is also offered in "magazine and cassette" or "magazine and disc" sets at $75.00 and $125.00 per year, respectively. Softside would be of interest to those who have extensive experience and/or training with microcomputer hardware and software.

T.H.E. Journal (Technological Horizons in Education) is a general

periodical which includes articles on all phases of new and traditional technology. It is published six times per year by Information Synergy, Inc., P. O. Box 992, Acton, MA 01720. Subscriptions are free on a limited basis or $15.00 per year. Requests for free subscriptions on University or school district letterhead are usually honored.

Educational Computer Magazine was begun in 1981. It is a bi-monthly publication of Educational Computer, P. O. Box 535, Cupertine, CA 95015. Cost is $12.00 per year.

The Intelligent Machines Journal is a tabloid sized newspaper published "approximately biweekly." It was available from 345 Swett Road, Woodside, CA 94062. It is not as comprehensive or as regularly published as Infoworld.

Byte is designed for more experienced users and is available from 70 Main Street, Peterborough, NH 03458.

Kilobaud is published at the same address as Byte, but is for beginners as well as the more experienced.

Recreational Computing is published by the People's Computer Company, 1263 El Camino Real, Box 3, Menlo Park, CA 94025.

Scientific American, in 1977, published a series of articles on microelectronics. These are available in offprint from W. H. Freeman and Company, 660 Market Street, San Francisco, CA 94104. The reprints include:

Kay, A. C. Microelectronics and the Personal Computer

Noyce, R. N. Microelectronics

Meindl, J. D. Microelectronic Circuit Elements

Holton, W. C. The Large-Scale Integration of Microelectronic Circuits

Oldham, W. G. The Fabrication of Microelectronic Circuits

Hodges, D. A. Microelectronic Memories

Toong, H. M. D. Microprocessors

Terman, L. M. The Role of Microelectronics in Data Processing

Oliver, B. M. The Role of Microelectronics in Instrumentation and Control

Mayo, J. S. The Role of Microelectronics in Communication

Sutherland, I. E. & Mean, C. A. Microelectronics and Computer Science

These reprints give a useful if highly technical description of the impact of the silicon chip on a variety of technologies.

MicroSIFT News is published irregularly by the Northwest Regional Educational Laboratory, 300 S.W. Sixth Avenue, Portland, OR 97204. Includes courseware evaluations and will in future include a MicroSIFT courseware information database called RICE: Resources in Computer Education.

Journal of Educational Technology Systems is a quarterly which began publishing in 1972. Cost is $51.00 per year and it is available from Baywood Publishing Co., 43 Central Avenue, Farmingdale, NY 11935.

Media and Methods Magazine is available from North American Publishers, 401 North Broad Street, Philadelphia, PA 19103. It was started in 1966 and publishes 9 issues per year at an annual cost

of $9.00, or $2.00 per issue. It carries articles on general media and methods used by teachers, librarians, and audio visual specialists.

Classroom Computer News is published by Intentional Educations, 51 Spring Street, Watertown, MA 02172.

Interface Age is a non-technical monthly magazine containing reports on hardware and software development, software programs in the public domaine, and articles of interest to the general or beginning microcomputer user. Each issue contains an education column of general interest to educators. It is published monthly by McPheters, Wolfe, & Jones, 16704 Marquardt Ave., Cerritos, CA 90701. Cost is $18.00 per year.

Pipeline is published twice a year by CONDUIT and contains reviews of educational software packages recently developed, especially those for the TRS-80, Apple I, and Commodore Pet machines. Most reviews are for secondary or post-secondary application. CONDUIT is an association of colleges and universities supporting the development of educational uses of computers. CONDUIT also acts as a publisher of post-secondary software which meets its high standard for quality. A catalog of CONDUIT software, as well as Pipeline, is available from CONDUIT, P. O. Box 388, Iowa City, IA 52244. Incidentally, Vol. 5, #2 (Fall, 1980) carries an excellent discussion of laser videodisc technology.

Silicon Gulch Gazette is published 4 times per year by Wireless Digital Incorporated, 333 Swett Rd., Woodside, CA 94062. Subscription price is $6.00 per year but random issues will be

sent without charge upon request. It carries much up-to-date information on the various computer fairs held on the west coast.

Softside Monthly is a publication of Softside Publication, 6 South Street, Milford, NH 03055. It primarily specializes in software applications for Apple, Atari, and TRS-80. Cost is $3.00 per issue or $30.00 per year.

Source World is a magazine published by Source Telecomputing Corporation to support THE SOURCE, an information utility subsidiary of The Reader's Digest Association, Inc. Cost is $2.00 per copy from 1616 Anderson Road, McLean, VA 22102.

Videonews is a biweekly newsletter on the management, marketing and regulation of VCRs, videodiscs, text services and programming. It may be obtained from Videonews, 7315 Wisconsin Avenue, Suite 1200N, Bethesda, MD 20814. Cost is $167.00 per year.

BOOKS

Evans, Christopher. The Micro Millenium. (1979) A Washington Square Press/Pocket Books Publication, 1230 Avenue of the Americas, New York, NY 10020.

This book is the best single introduction to the impact of the microcomputer currently available. It contains an excellent lay person's history of the computer, examines the political, economic and sociological implications of the microcomputer revolution, and examines thoroughly the philosophical issues surrounding artificial intelligence.

Norman, Colin. Microelectronics At Work: Productivity and Jobs in the World Economy. Worldwatch Paper 39, (October, 1980) 1776

Massachusetts Ave. N.W. Washington, D.C. 20036. USA

This brief essay clearly documents the necessity for any nation/state desirous of influence in 2000 to pursue microelectronics domination now. Available for $2.00 from the publisher.

Maddison, John. National Education and the Microelectronics 'Revolution.' (1979) Clevedon Printing Co., Ltd., Clevedon, Avon BS21 72W, England.

This is an annotated bibliography and a media resources list focusing on the status of microelectronics in Great Britain.

Masuda, Yoneji. The Information Society as Post-Industrial Society. The World Future Society, 4916 St. Elmo Anenue, Bethesda, MD 20814. Available for $12.50 from the publisher.

Masuda is an early pioneer of computerization in Japan. This book is the result of his work with the Japan Institute for the Information Society in developing a plan for Japan's National Goal: Toward the Year 2000. A startling look at the future by a person in a country which will propel us there, this book argues that the "information society" which will replace the industrial society will bring about enormous positive changes for humankind.

The Techno-Peasant Survival Manual. A paperback available from Bantom Books for $8.95.

Written by a group of educators and professionals, this book covers a wide range of topics in terms easily understood and comprehended by beginners. Topics include the microcomputer, lasers, fibre optics, genetic engineering and nuclear fusion.

Toffler, A. The Third Wave. (1980) Morrow, 105 Madison Ave., NY., 10016.

Walter, Russ. Secret Guide to Computers. Tenth Edition. (1982) An eight volume set which is excellent for the beginner, these volumes sell for $3.70 each or $29.60 for the set. There is an introductory and advanced volume for each of four topics: Basic, Languages, Systems, and Applications. Write Russ Walter, 92 St. Botolph Street, Boston, MA 02166. Russ will also answer your specific questions about your microcomputer if you call him at 617-266-8128.